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Claim Amendments
Including a complete listing of all claims

1. (Currently Amended) Vertical cavity surface emitting laser, which emits the fundamental transverse radiation mode only, comprising:

a laser active region, a resonator having a first reflector and a second reflector,

wherein the first reflector ~~comprising~~ comprises a first plurality of doped layers having alternately a low index of refraction and a high index of refraction, an aperture layer located above said first plurality of doped layers and formed of an insulating material that is substantially non-transparent for a specified wavelength range, the aperture layer having an aperture formed of conductive and optically transparent material with a first characteristic lateral size (d_{ox}), and a second plurality of doped layers having alternately a low Index of refraction and a high Index of refraction, the second plurality having a second characteristic lateral size (dm), a difference of the first characteristic lateral size (d_{ox}), and

wherein the second characteristic lateral size (d_m) being smaller than the first characteristic lateral size (d_{ox}) and being adapted to generate increased optical losses of said resonator with respect to higher order modes for said specified wavelength

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range compared to the optical losses caused by said aperture layer alone, and

a radiation output window formed above said first reflector or below said second reflector,

whereby the vertical cavity surface emitting laser behavior is determined by the interplay of at least two different design or characteristic dimensions and therefore a deviation of one parameter or dimension from a target value may not unduly compromise performance.

2. (Original) The vertical cavity surface emitting laser of claim 1, wherein said radiation output window has a third characteristic lateral size that is less than the first and the second characteristic lateral sizes.

3. (Previously Presented) The vertical cavity surface emitting laser of claim 1, wherein said radiation output window is formed in a metal layer.

4. (Previously Presented) The vertical cavity surface emitting laser of claim 1, wherein said first characteristic lateral size is equal to or greater than 5 μm.

5. (Previously Presented) The vertical cavity surface emitting laser of claim 4, wherein said first characteristic lateral size is equal to or greater than 6 μm.

6. (Currently Amended) The vertical cavity surface emitting laser of claim 1, wherein an absolute amount of said difference of the first characteristic lateral size and the second characteristic maximum lateral size is in the range of 6 μm to 4 μm.

7. (Currently Amended) The vertical cavity surface emitting laser of claim 1, wherein an absolute amount of said difference of the first characteristic lateral size and the second characteristic maximum lateral size is ~~in the range of~~ substantially 4 μm.

8. (Currently Amended) The vertical cavity surface emitting laser of claim 2, wherein said third characteristic lateral size is in the range of 4 to 7 μm.

9. (Previously Presented) The vertical cavity surface emitting laser of claim 1, further comprising a third plurality of doped layers having alternately a low index of refraction and a high index of refraction, the third plurality of doped layers

being disposed between said aperture layer and said second plurality of doped layers and having a characteristic lateral size that is greater than said second characteristic size.

10. (Previously Presented) The vertical cavity surface emitting laser of claim 1, wherein the number of doped layers in said first plurality is equal to or less than 9.

11. (Original) The vertical cavity surface emitting laser of claim 9, wherein the number of doped layers in said third plurality is equal to or less than 9.

12. (Previously Presented) The vertical cavity surface emitting laser of claim 1, wherein said second reflector comprises a plurality of doped layers having alternately a low index of refraction and a high index of refraction.

13. (Original) The vertical cavity surface-emitting laser of claim 12, further comprising a substrate carrying said second reflector on one surface and a metal layer formed on the opposite surface of the substrate.

14. (Previously Presented) The vertical cavity surface emitting laser of claim 1, further comprising a contact layer

formed between said laser active region and at least a portion of said second reflector, said contact layer being configured to electrically connect said active region to a contact pad.

15. (Previously Presented) The vertical cavity surface emitting laser of claim 1, wherein said first characteristic lateral size is equal to or less than said second characteristic lateral size.

16. (Previously Presented) The vertical cavity surface emitting laser of claim 1, wherein said first characteristic lateral size is greater than said second characteristic lateral size.

17. (Previously Presented) The vertical cavity surface emitting laser of claim 1, further comprising a phase matching layer formed within said resonator, the phase matching being configured to shape the transverse reflectivity of said resonator so as to suppress higher transverse radiation modes.

18. (Original) The vertical cavity surface emitting laser of claim 17, wherein said phase matching layer is provided above said second plurality of doped layers.

19. (Previously Presented) The vertical cavity surface emitting laser of claim 1, wherein said aperture and said second plurality of doped layers have a substantially circular shape and said first and second characteristic lateral sizes represent a first diameter and a second diameter, respectively.

20. (Previously Presented) The vertical cavity surface emitting laser of claim 1, wherein said radiation output window has a substantially circular shape.

21. (Previously Presented) The vertical cavity surface emitting laser of claim 1, wherein at least one of said aperture and said second plurality of doped layers has a non-circular shape to provide different optical losses for different polarization states of a low-order radiation mode of said specified wavelength range.

22. (Previously Presented) The vertical cavity surface emitting laser of claim 1, wherein said radiation output window has a non-circular shape to provide different optical losses for different polarization states of a low-order radiation mode of said specified wavelength range.

23. (Previously Presented) A method of forming a vertical cavity surface emitting laser, which emits the fundamental transverse radiation mode only, the method comprising:

selecting a target output wavelength range,

selecting appropriate semiconductive materials for a laser active region and a first and second reflector, wherein the first reflector includes a first plurality of doped layers and a second plurality of doped layers with an aperture layer arranged therebetween,

determining a minimum acceptable lateral size of an aperture formed in said aperture layer,

correlating at least two of the following characteristic dimensions of the vertical cavity surface emitting laser, a first characteristic lateral size representing a lateral extension of said aperture, a second characteristic lateral size representing a lateral extension of said second plurality of doped layers, a third characteristic lateral size representing a lateral size of a radiation output window, a vertical distance between said laser active region and said aperture layer and a vertical distance between said aperture layer and said second plurality of doped layers, so as to increase optical losses of higher radiation modes than are obtained with said minimum acceptable lateral size alone, wherein said first characteristic lateral size is equal to or higher than said minimum acceptable lateral size, and

forming said laser active region, said first and second reflectors and said radiation output window according to dimensions determined during said correlating step.

24. (Previously Presented) The method of claim 23, wherein said minimum acceptable lateral size is selected so as to maintain a current density below a critical threshold for an output power of 1 mWatt and more.

25. (Previously Presented) The method of claim 23, wherein said minimum acceptable lateral size is 5 μm or more.

26. (Previously Presented) The method of claim 23, wherein said minimum acceptable lateral size is 6 μm or more.

27. (Previously Presented) The method of claim 23, wherein correlating at least two characteristic dimensions includes:

varying one or more of the characteristic dimensions while keeping at least one characteristic dimension constant, and

determining at least one of an output power and an output wavelength for a specified operating range.

28. (Previously Presented) The method of claim 23, wherein correlating at least two characteristic dimensions includes

calculating an optical field within said resonator for a plurality of value combinations and determining a design value range for at least one of the at least two characteristic dimensions for at least one of a desired output power and a spectral purity.

29. (Previously Presented) The method of claim 23, further comprising specifying process margins for said at least two characteristic dimensions on the basis of said correlation.

30. (New) A vertical cavity surface emitting laser having a desired output comprising:

a metal layer having a radiation output window;

a first reflector comprising a first plurality of doped layers with alternating low and high indexes of refraction, an aperture layer, a third plurality of doped layers, and a second plurality of doped layers;

a laser active region; and

a second reflector comprising a plurality of doped layers with alternating low and high indexes of refraction;

wherein the aperture layer has an aperture with a first predetermined lateral dimension, the second plurality of doped layers has a second predetermined lateral dimension, and the

third plurality of doped layers has a predetermined thickness; and

wherein the second predetermined lateral dimension and the predetermined thickness are selected based on an actual measurement of the first predetermined lateral dimension so as to maintain the desired output of the vertical cavity surface emitting laser,

whereby the deviation of the actual measurement of the first predetermined lateral dimension from an intended first predetermined lateral dimension is compensated for without compromising the desired output of the vertical cavity surface emitting laser.

31. (New) A method of making a vertical cavity surface emitting laser having a desired output comprising the steps of:

forming a reflector on a substrate;

forming a laser active region on the substrate;

forming a first doped layer on the laser active region;

forming an aperture layer on the first doped layer, the aperture layer having an aperture with a first intended predetermined lateral dimension selected so as to provide the desired output of the vertical cavity surface emitting laser;

measuring the first intended predetermined lateral dimension of the aperture to obtain an actual lateral dimension formed;

calculating an adjustment to a device dimension of subsequent layers so as to compensate for the deviation between the intended predetermined lateral dimension of the aperture and the actual lateral dimension formed, whereby the desired output is maintained;

forming a third plurality of doped layers on the aperture layer, the third plurality of doped layers having a number of layers determined by said step of calculating an adjustment;

forming a second plurality of doped layers on the third plurality of doped layers, the second plurality of doped layers having a predetermined lateral dimension determined by said step of calculating an adjustment; and

forming a metal layer having a radiation output window on the second plurality of doped layers,

whereby the actual lateral dimension formed in the aperture is used to calculate adjustments in a device dimension of subsequent layers so as to maintain the desired output.